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Utilization of a model lung system to assess the effects of an inspiratory impedance threshold valve on the relationship between active decompression and intra-thoracic pressure

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Abstract

Use of an inspiratory impedance valve has recently been shown to increase the efficacy of standard and active compression-decompression cardiopulmonary resuscitation. We evaluated the effects of a prototypic impedance valve on the relationship between the active

decompression and intra-thoracic pressure using a mechanical model lung system. Intermittent impedance to inspiratory flow of respiratory gases during the decompression phase of active compression-decompression cardiopulmonary resuscitation significantly decreased the intra-thoracic pressure, while the pressure was almost zero cm H_2O during the cardiopulmonary resuscitation cycle when the impedance threshold valve was not functioning. Thus, this mechanical model will help in evaluating the valve as well as in optimizing its function by simulating various forms of lung disease.

Author Keywords: Active compression-decompression; Impedance; Lung

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Short communication

Use of an inspiratory impedance threshold valve during cardiopulmonary resuscitation: a progress report

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Abstract

Building upon studies on the mechanism of active compression-decompression (ACD)

cardiopulmonary resuscitation, a new inspiratory impedance threshold valve has been developed to enhance the return of blood to the thorax during the decompression phase of CPR. Use of this device results in a greater negative intrathoracic pressure during chest wall decompression. This leads to improved vital organ perfusion during both standard and ACD CPR. Animal and human studies suggest that this simple device increases cardiopulmonary circulation by harnessing more efficiently the kinetic energy of the outward movement of the chest wall during standard CPR or active chest wall decompression. When used in conjunction with ACD CPR during clinical evaluation, addition of the impedance valve resulted in sustained systolic pressures of greater than 100 mmHg and diastolic pressures of greater than 55 mmHg. The new valve may be beneficial in patients in asystole or shock refractory ventricular fibrillation, when enhanced return of blood flow to the chest is needed to `prime the pump'. The potential long-term benefits of this new valve remain under investigation.

Author Keywords: Inspiratory impedance threshold valve; Cardiopulmonary resuscitation; Active compression-decompression (ACD)

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Effectiveness of mask ventilation in a training mannikin. A comparison between the Oxylator EM100 and the bag-valve device

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Abstract

The demands for an optimal **ventilation** apparatus are that it can be easily handled, achieves a sufficiently high **ventilation** volume, and minimizes gastric inflation. Our aim was therefore to carry out a study in a training mannikin to find out whether the Oxylator EM100, compared with the **bag,** obtains improved **ventilation** and a decrease in gastric inflation. In a randomized crossover study, 72 subjects were selected (24 physicians, 44 nurses and 4 auxiliary nurses), chosen from the operating theatre, emergency department and intensive care unit of two hospitals. We used the **Ambu**®-**Bag** Mark III with mask No.

4, the Oxylator EM100 with a pressure setting of 35 cm H_2O run in the manual setting, the **Ambu**®-Man C mannikin as well as the **Ambu**®-**CPR** computer program. The **resuscitation** cycles of the standard two-rescuer's adult procedure lasted 3 min each, with a 3-min pause between the crossover procedure. The participants could improve their ventilatory volume with the Oxylator EM100 by 635 ml (95% confidence interval 578–692 ml) compared with the **bag ventilation.** The number of subjects who could attain a mean ventilatory volume of 800 ml or more increased from 15% to 98.6% ($P<0.001$). Compared with the **bag,** the increase of adequate **respirations** ($\geq$800 ml) obtained by the Oxylator EM100 for the individual participants amounted to a median of 91% ($P<0.001$). Moreover, conventional **ventilation** caused in 42% one or several instances of gastric inflation, whereas no such reactions occurred with the Oxylator EM100. The Oxylator EM100 showed significantly better results in the mannikin than the **bag.** Of most importance is a significant lowering of gastric inflation and less so a marked increase in ventilatory volume. Our trial procedure with a relatively high lung compliance and a high oesophageal sphincter opening simulated favorable conditions. Owing to a large in vivo variability of these magnitudes, a direct testing in real patients with circulatory arrest is indicated.

Author Keywords: Mask **ventilation**; Training mannikin; Comparison; Oxylator EM100; **Bag**-valve device

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